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Communications Academy
Emergency Communications

Public Safety Broadband and EMS

Andrew M. Seybold, W6AMS

Andrew Seybold

- Current Public Safety Involvement
  - Communications Advisor to
    - Public Safety Alliance (PSA)
    - National Sheriffs' Association (NSA)
    - International Association of Chiefs of Police (IACP)
  - Vice-Chairman, APCO Broadband Committee and
    - Sub-Committee on Nationwide Broadband Architecture
  - Co-Chairman of Operators Advisory Council (OAC)
    - Sub-Committee on Broadband Interoperability
  - Member National Public Safety Telecommunications Council (NPSTC)
    - Broadband Committee
  - NSA Representative
    - Public Safety Advisory Council (PSAC) to the FCC (disbanded)
  - Public Safety Communications Consultant
    - Multiple Public Safety Agencies and vendor clients

Andrew Seybold, W6AMS

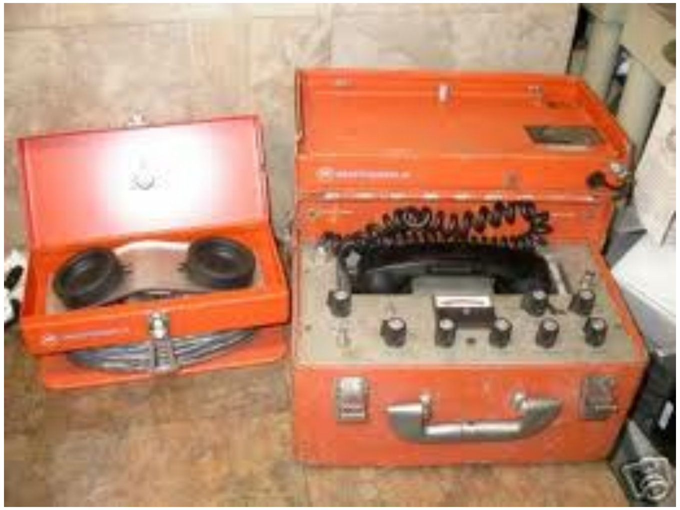
- First licensed in 1962
- Emergency Communications Activities
  - Director, Delaware County CD Communications
  - ARES
    - EC Butler County, Ohio
    - EC San Lorenzo Valley, Santa Cruz County, CA
    - Member Santa Barbara, CA
  - Founding member, Northeast FM Repeater Association
  - Founding member, Philadelphia Amateur Repeater Assoc. (PARA)
  - VP of External Affairs, Santa Barbara Amateur Radio Club (SBARC)
  - Member, SBARC technical committee
  - Founding member and CEO, Santa Barbara Telecommunications Advisory Council (SBTAC)
  - Member of ARRL since 1962

Broadband and EMS

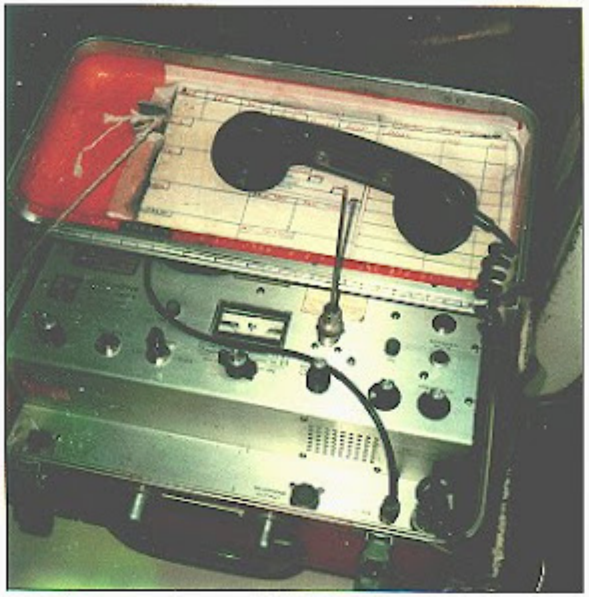
- EMS Communications Then and Now
- The Future of EMS Communications
- What Will Enable All of This
- The New Law and Public Safety Broadband
- What Broadband LTE Is
- The Differences Between Land Mobile Radio and LTE
- Learning to Speak a New Wireless Language
- Public Safety LTE Devices—What Is Coming
- What Broadband Will Do for Public Safety
- What Is Going On in Seattle
- Public Safety Broadband Changes Everything!
- Questions and (some) Answers

EMS Communications: The Beginning

1972 Biocom Paramedic Radio
Full duplex voice, EKG
3-lead EKG
10 Watts, 1 hour battery
15 minute recharge



The BioPhone



EMS Communications Today

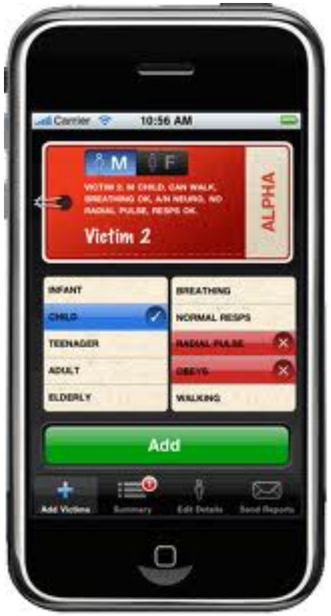
Full 12-lead EKG from scene to hospital displays on iPhone and iPad. Makes use of commercial 3G broadband network when available—which is not the case during most incidents!

That Was the Beginning

This Is the Future!

Public Safety Broadband and EMS

Full 12-lead EKG
Portable ultrasound
From-scene video while responding
Triage video to hospital
Handheld triage device
Much more!



VICTIM 2: M CHILD, CAN WALK, BREATHING OK, A/N NEURO, NO RADIAL PULSE, RESPS OK.

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What Will Enable All of This

Public Safety’s Own Broadband Network

Public Safety Broadband, What It Is

- Starts with new, nationwide Public Safety Radio License for 20 MHz of 700 MHz spectrum
- Will be fully interoperable on a nationwide basis
- Network will provide Public Safety with mission-critical
  - High-speed data services
  - Video from dispatch to responders, responders to dispatch
  - New first responder applications and services for day-to-day and incident management, GPS location services, and much more
- Will provide same types of services citizens have with smartphones but on hardened, mission-critical network CONTROLLED by Public Safety, NOT commercial network operators
- Will be based on commercial 4G technology (LTE)
- Will bring Public Safety into the 21st century

How We Got Here

- Public Safety had 10 MHz of broadband spectrum
- Second 10 MHz (D Block) was to have been auctioned for a public/private partnership network for both a commercial operator and Public Safety
  - No commercial operator bid on the spectrum
- Public Safety launched effort to obtain D Block and funding for the network
- Opposed by some in Congress, some network operators that wanted to auction the spectrum for the money
  - FCC, some in Congress maintained that Public Safety did not need the spectrum
- Three years ago we were told we would never get the spectrum and funding for the network

What Public Safety Did

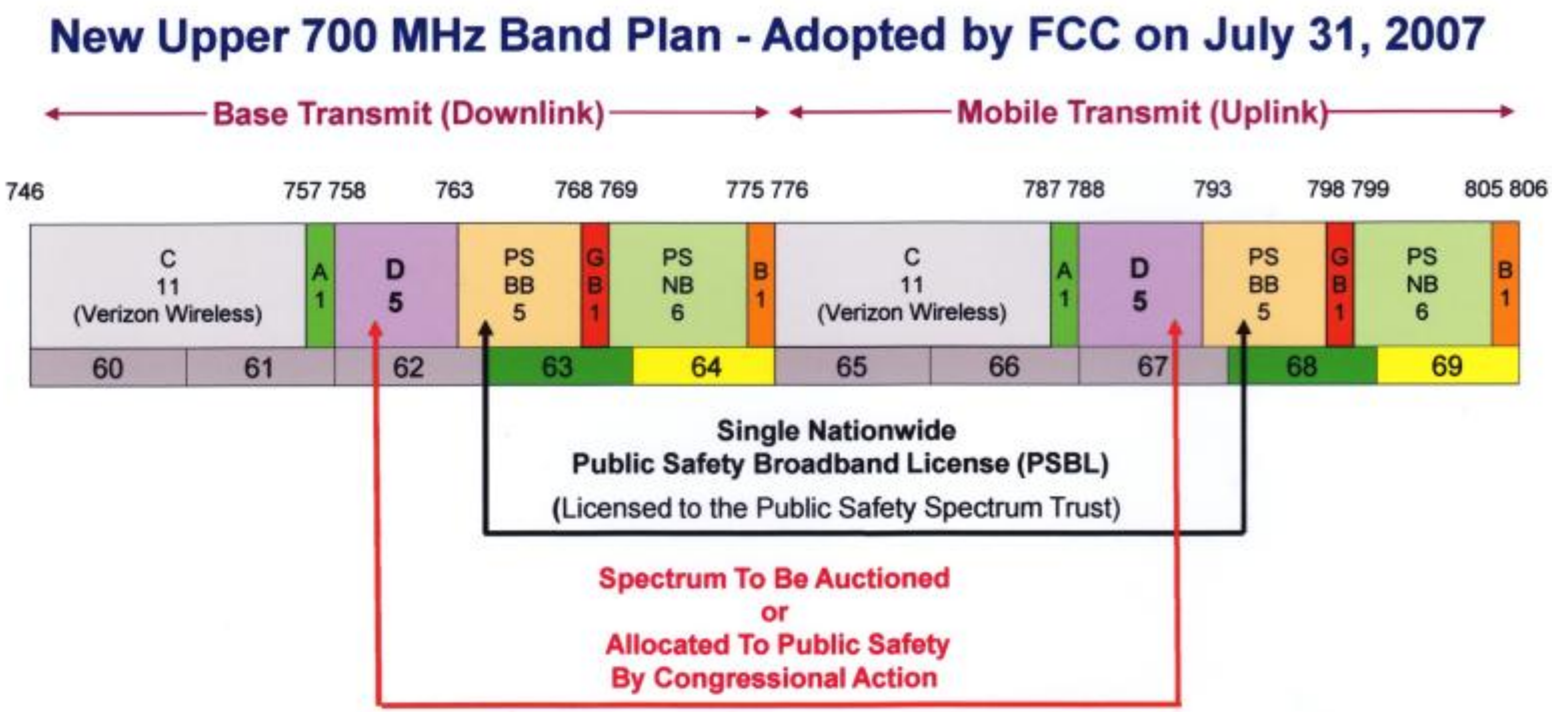
- Walked the halls of Congress for 3 years
  - Met with staffers and members of Congress
  - Testified at numerous Congressional hearings
  - Supported our case with thousands of pages of technical documents proving we need the spectrum and funding
- Came together as never before
  - Fire, EMS, Sheriffs, Police all came together to work toward this goal
  - Mayor’s and Governor’s associations joined the fight
  - Executive Branch was convinced to support us
- Tide turned with support from
  - Senators Rockefeller, McCain, and Lieberman
  - Followed by support from Representative Peter King
  - We proved we needed all of the spectrum; not only our portion
- A team effort unlike anything Public Safety had seen before

The Public Safety Alliance (PSA)

- A partnership of the nation’s leading Public Safety Associations
  - Association of Public Safety Communications Officials (APCO)
  - International Association of Chiefs of Police (IACP)
  - **International Association of Fire Chiefs (IAFC)**
  - National Sheriffs’ Association (NSA)
  - Major City Chiefs Association (MCCA)
  - Major County Sheriffs Association (MCSA)
  - **Metropolitan Fire Chiefs Association (MFCA)**
  - **National Emergency Management Association (NEMA)**
  - **National Association of State EMS Officials (NAEO)**

International Association of Chiefs of Police | International Association of Fire Chiefs
National Sheriffs' Association | Major Cities Chiefs Association
Major County Sheriffs' Association | Metropolitan Fire Chiefs Association
Association of Public-Safety Communications Officials International
National Emergency Management Association | National Association of State EMS Officials

Public Safety Spectrum Holdings: 700 MHz



New Upper 700 MHz Band Plan - Adopted by FCC on July 31, 2007

Single Nationwide
Public Safety Broadband License (PSBL)
(Licensed to the Public Safety Spectrum Trust)

Spectrum To Be Auctioned
or
Allocated To Public Safety
By Congressional Action

- Public Safety had 10 MHz of nationwide broadband spectrum
- Now have additional 10 MHz (known as D Block)
- Law includes funding and governance structure
- This spectrum is adjacent to Verizon and Public Safety narrowband

HR 3630 as Passed and Signed into Law

TITLE VI: PUBLIC SAFETY SPECTRUM

H.R. 3630 Title VI

- Passed Congress February 17, 2012
- Signed in to law by President Obama February 22, 2012
- Quick Summary
  - Requires FCC to allocate D Block spectrum to Public Safety
  - Establishes First Responder Network Authority (FirstNet) to govern Public Safety Broadband Network (PSBN)
  - Provides $7 billion in funding to build out nationwide Public Safety broadband network
  - Provides $135 million for state and local implementation grants with a 20% non-federal match
  - Provides up to $300 million for research and development grants
  - Provides $115 million for 9-1-1 and NG 9-1-1 grants
  - Requires give-back of the T-Band (470-512 MHz) used in 13 Metro areas
    - Shared TV spectrum

What All of This Means

GOOD NEWS / NOT SO GOOD NEWS

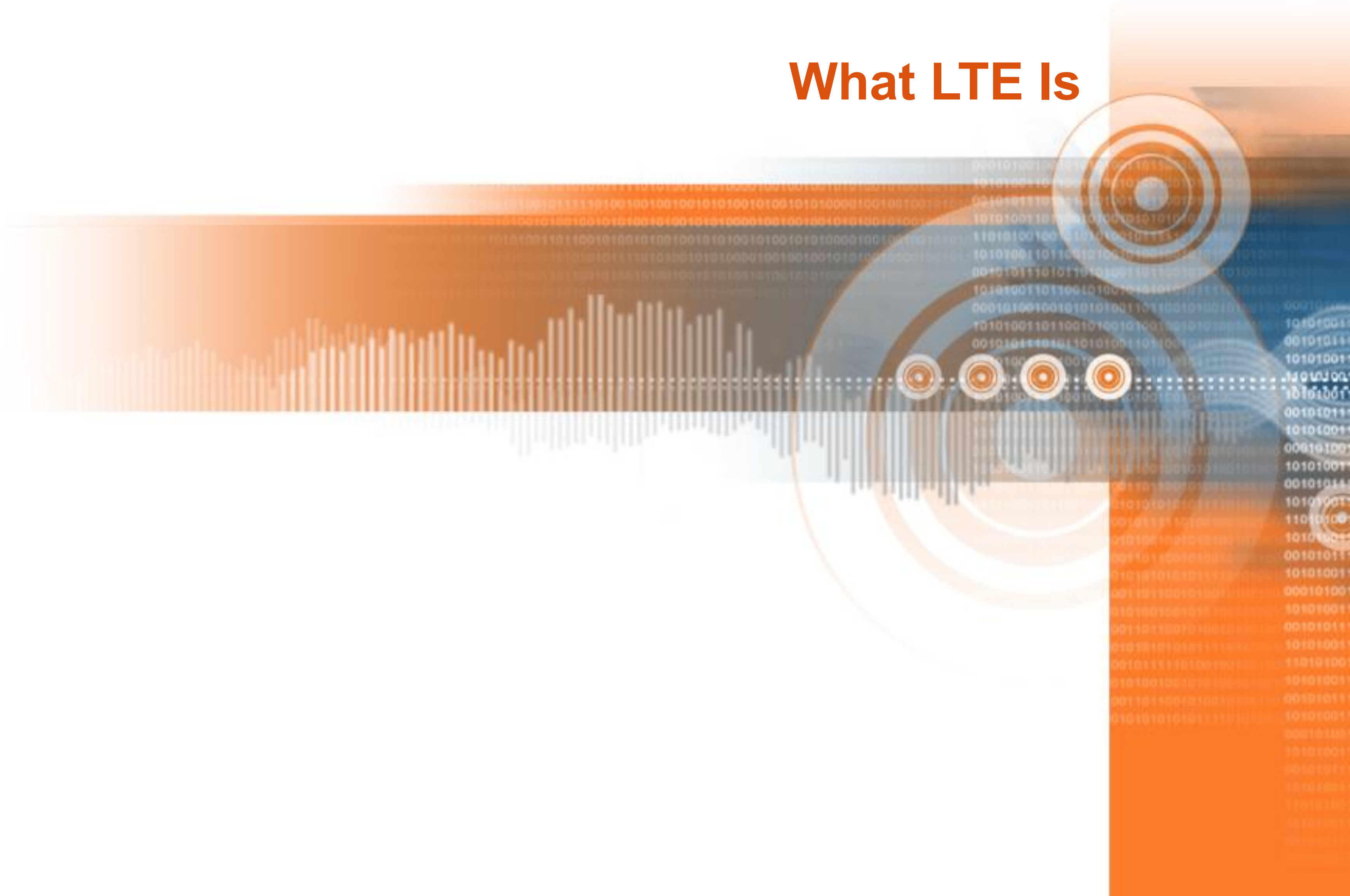
The Good News

- Nationwide, fully interoperable 4th-generation broadband network
  - When completed will cover 96% of U.S. population
  - First responders will be able to use data and video anywhere
- Devices will be less expensive than current Public Safety radio equipment
- This network will AUGMENT, NOT REPLACE existing land mobile radio systems
  - Voice will be added over time, estimate 2020 or later
- User devices will start out as in-vehicle modems, evolve to handhelds, tablets, other hand-carried form factors
  - Future devices will combine broadband and Public Safety voice
  - R&D funding will drive device developments faster
  - Expect to see a slew of new EMS-centric devices coming soon

The Not So Good News

- $7 billion does NOT BEGIN to cover the cost of the planned network
  - My estimate is that total cost of network over time will be $30+ billion!
- Governance model is not ideal
  - FirstNet charged with working with states
  - No clear indication of how states will handle working with local jurisdictions
  - There are MANY unanswered questions
  - Until FirstNet is formed we won’t know how this will play out
- States must respond quickly to FirstNet
  - Perhaps too quickly for sound planning
- Still many unknowns about how this will unfold and the timeframe!

What LTE Is



What LTE Is

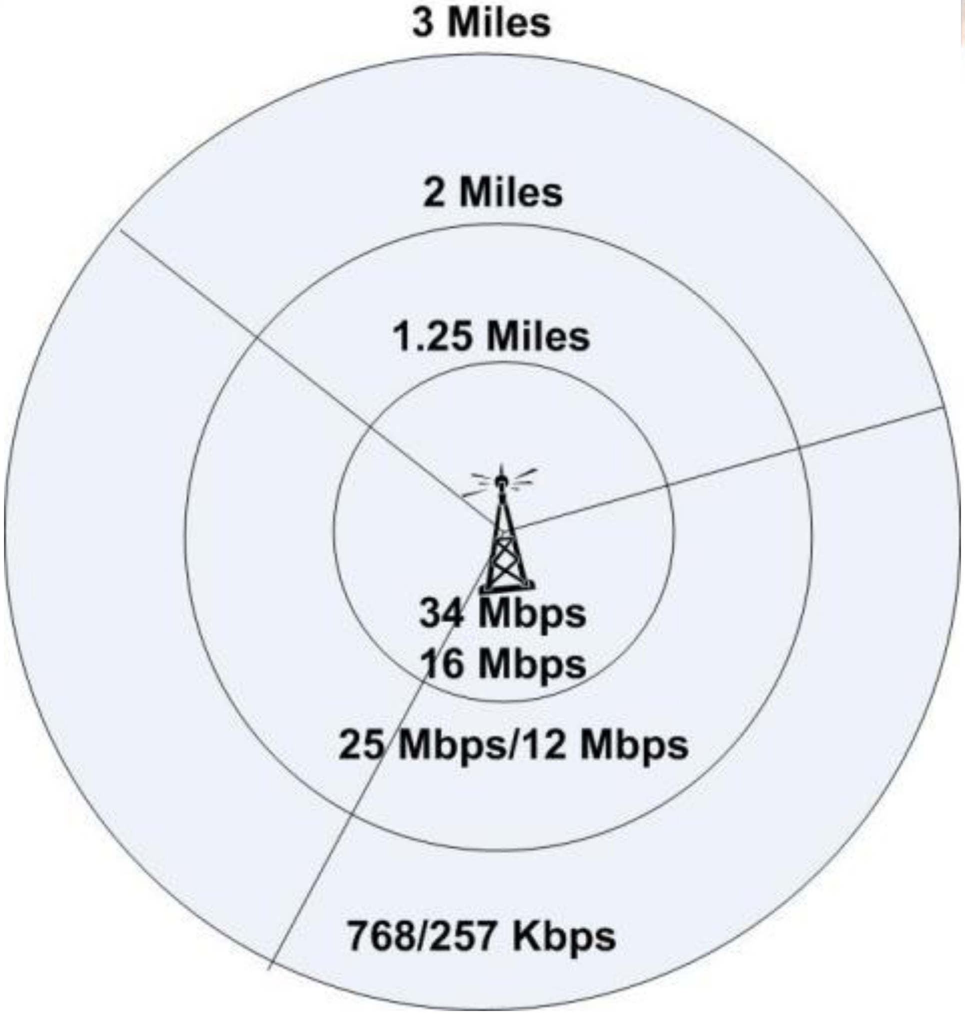
- LTE stands for Long Term Evolution
  - Standard developed by 3GPP organization
  - Networks and vendors tired of 1G, 2G, 2.5G, 4G names so LTE is really 4G technology
  - Unlike 1G, 2G, 3G that were designed for voice first with data added, LTE was designed for broadband data services first and foremost
    - Voice, using Voice over IP (VoIP) will be an add-on (at some point)
  - All-IP network
  - LTE refers to the airlink, which is based on OFDMA
    - Orthogonal Frequency-Division Multiple Access
    - Technology developed for high-speed data
  - LTE is all-IP-based system
    - IP over the airlink and through the backend of the system
    - Low latency—fast data, quick response
  - And you really don’t need to know any of this!

Typical LTE Cell Site at 700 MHz

Data Speeds down to device/up from device

Capacity in each sector shared by all users in the sector

These are typical numbers, may vary from system to system



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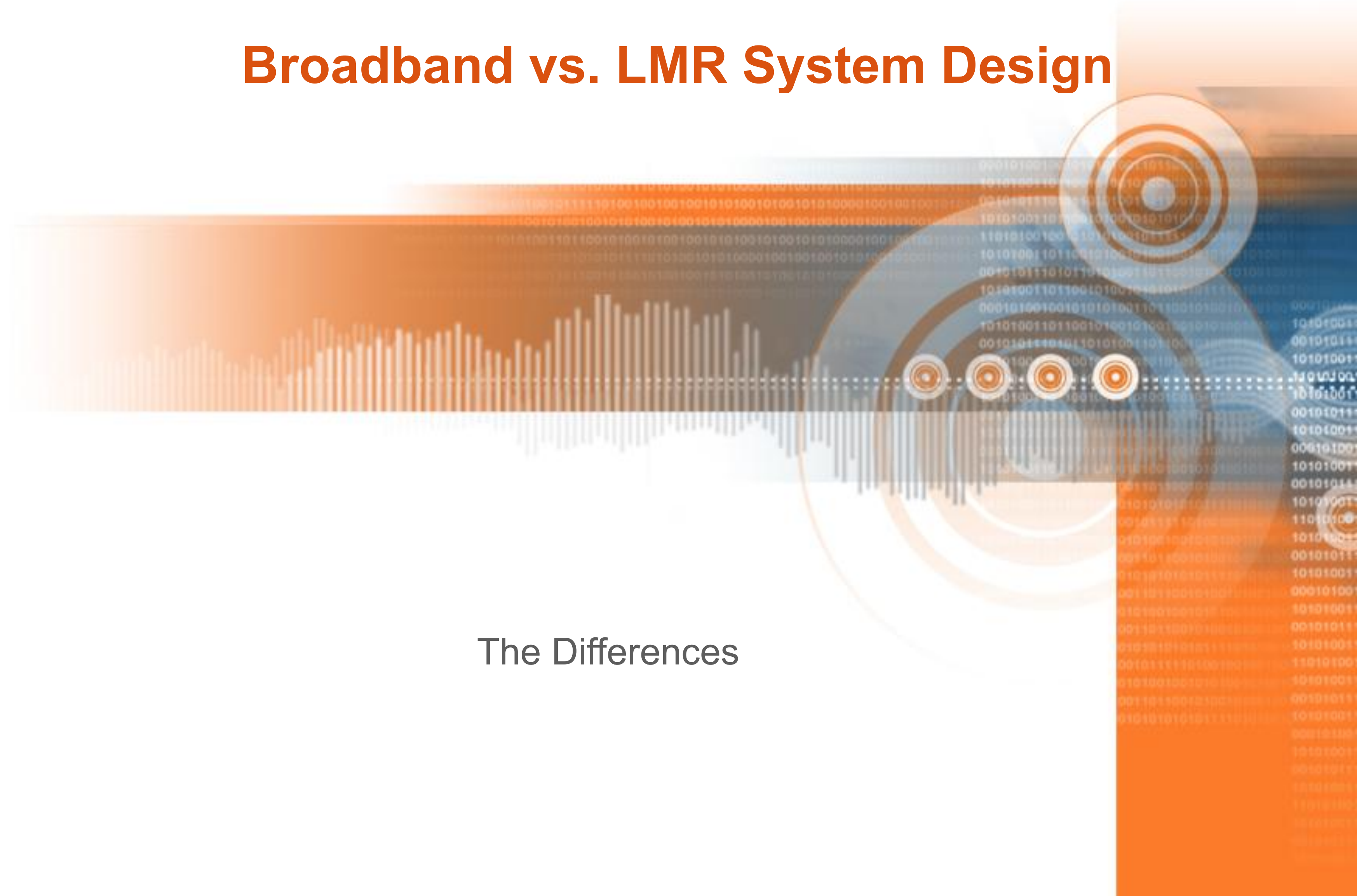
Broadband vs. LMR System Design



The Differences

LTE Broadband System Design

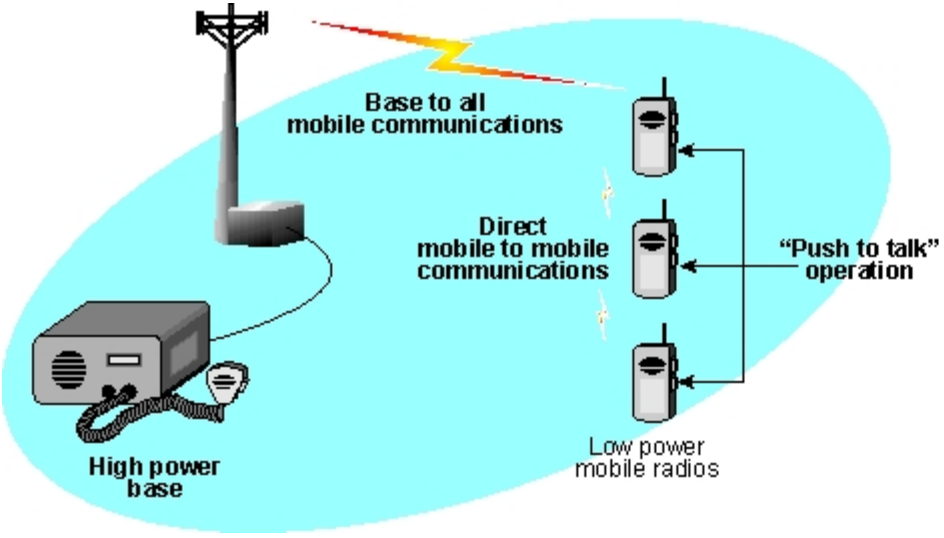
- LMR Systems Base
  - High-level sites
  - High-power transmit
  - Transmit as needed
  - Coverage 20-40 miles
  - Omni antenna
- LMR Mobile/HT
  - High power (5-100W)
  - External antennas
  - Talk-around simplex
- LTE Broadband Cell
  - Low-level sites
  - Low-power transmit
  - Transmits 24/7
  - Coverage 1-3 miles
  - Sectored antennas
- LTE Devices
  - Low power (200 MW)
  - Built-in antennas
  - MUST use cell site

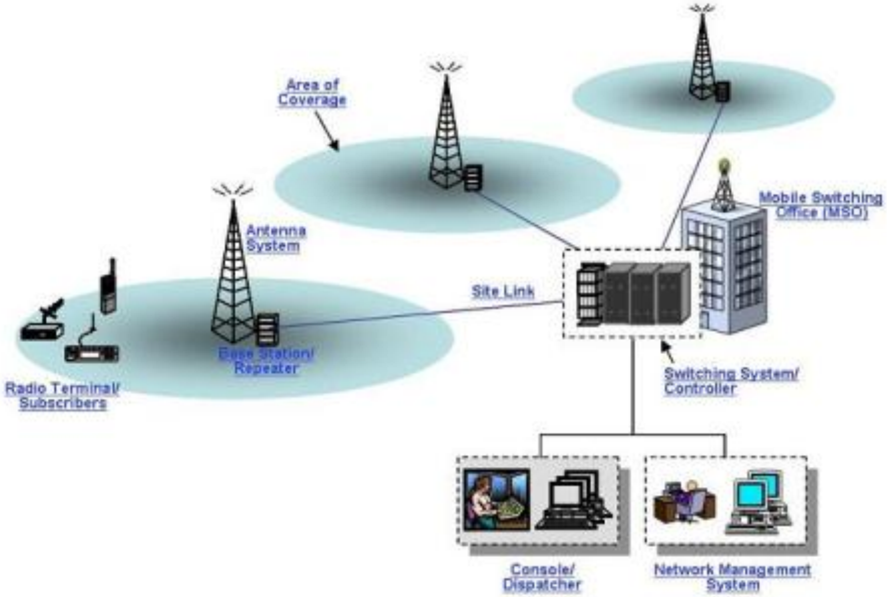
Other Differences

- LMR
  - Wireline/control station/ microwave
  - Low capacity requirements
  - Dumb networks
    - Trunked are semi-smart
  - Set and forget
  - External spkr/mic
  - Channel change by user

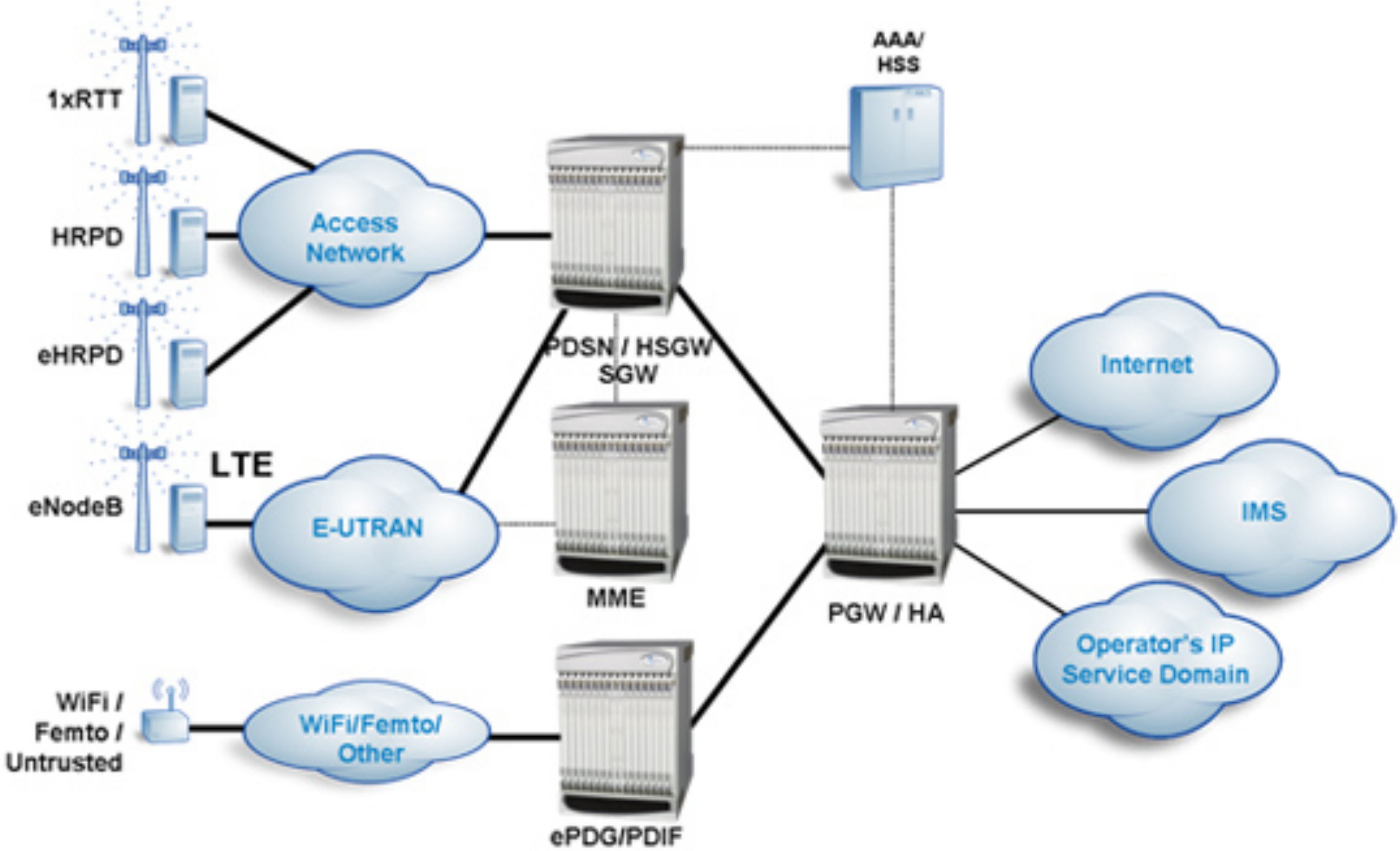
- LTE Broadband
  - Fiber/microwave
  - High capacity
    - 50+ Mbps per site
  - Smart cell sites
  - Requires network core
  - Modify perimeters to handle data demand on real-time basis
  - Channel change by network

Typical LMR System Diagram


Base to all mobile communications
Direct mobile to mobile communications
"Push to talk" operation
High power base
Low power mobile radios


Area of Coverage
Antenna System
Site Link
Mobile Switching Office (MSO)
Radio Terminal/ Subscribers
Base Station/ Repeater
Switching System/ Controller
Console/ Dispatcher
Network Management System

Typical LTE Broadband Systems



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Example of Sites Versus Coverage

- Santa Barbara County Fire
  - VHF (150 MHz)
  - 6 simulcast sites
  - Covers 95% of county
  - Indoor coverage good to 5W HT
  - Connections
    - Microwave
    - Control stations
  - One-to-many: yes

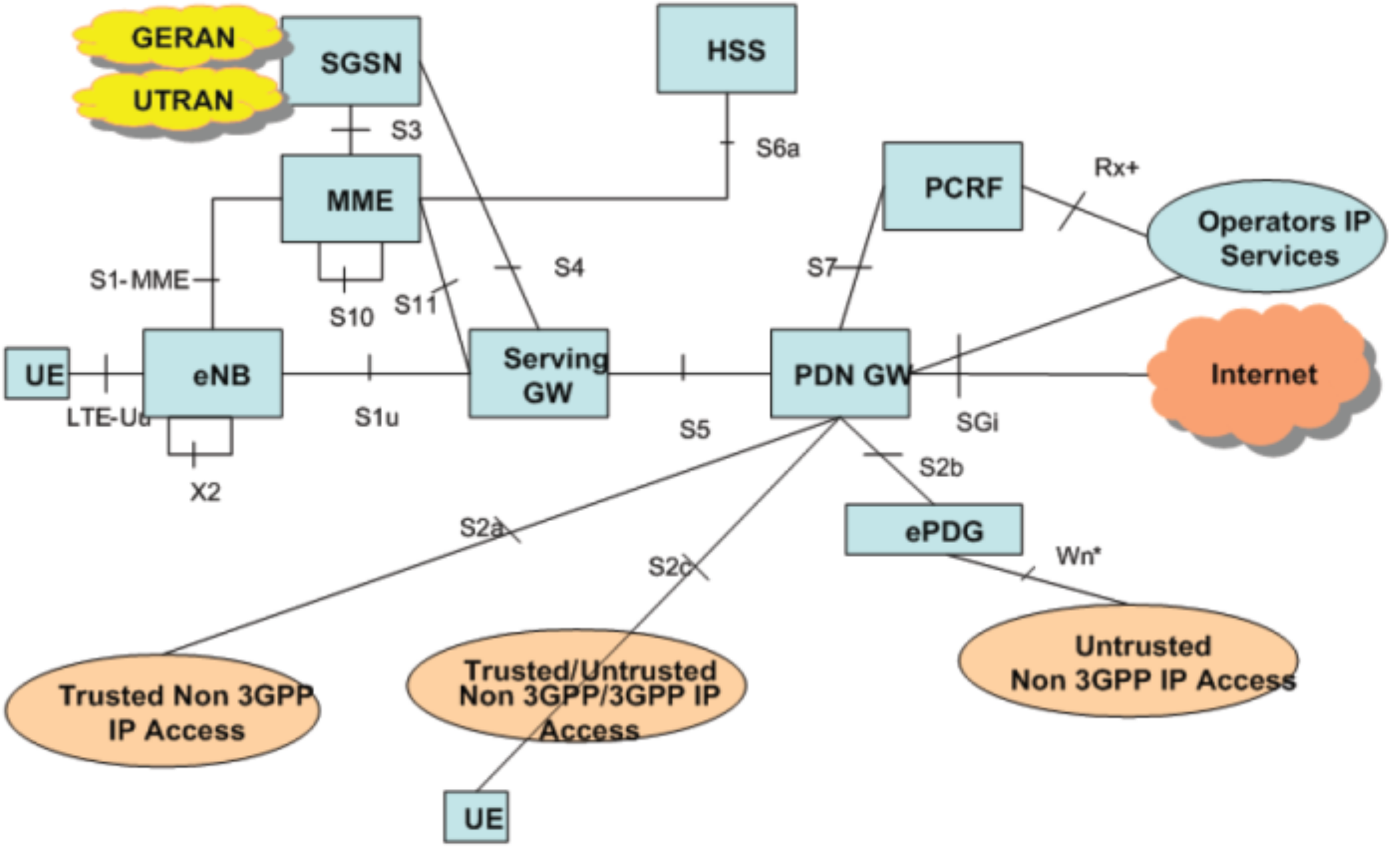
- LTE Broadband system (proposed)
  - 700 MHz
  - 62 sites
  - Covers 93% of county
  - Indoor coverage will be fair
  - Connections
    - Fiber
    - Microwave
  - One-to-many: no

LMR and LTE Terminology

LMR and LTE: Different Languages

LMR Speak	LTE Speak
Base station/repeater	eNodeB
Tower/radio location	RAN (Radio Access Network)
Mobile/HT	User device
Omni-directional antenna	Sectorized antennas
Output power in Watts – 5 Watts = 37 dBm	Output power in dBm – 30 dBm = 1 Watt
Connection to dispatch	Network backhaul
Simulcast	Multi-cast (future)
Narrowband voice	Broadband data

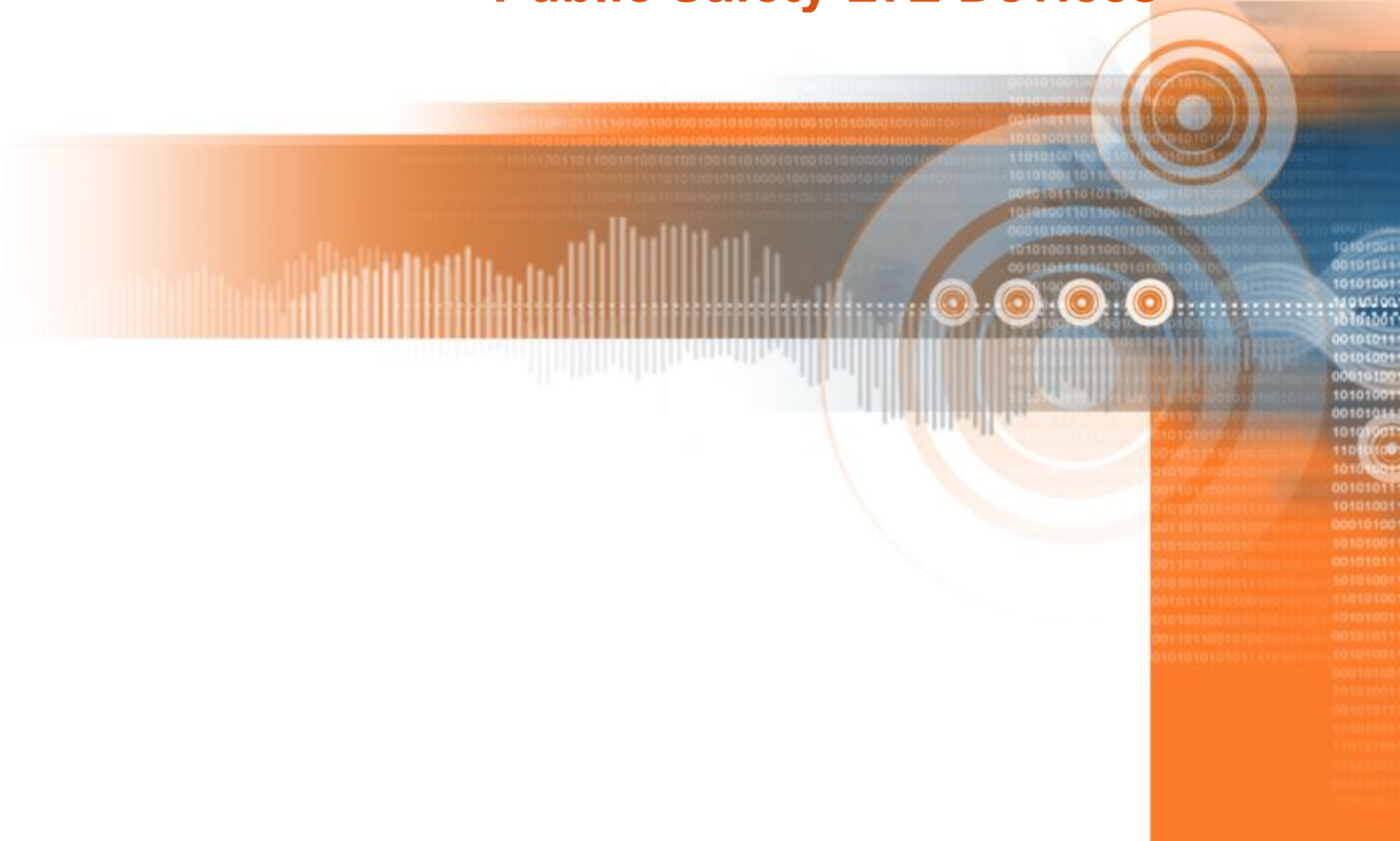
LTE Architecture: A Complex Network



LTE Systems Basics

- LTE is a complex broadband cellular architecture
- LTE has many built-in system and user controls
  - Some can be static, others designed to be changed dynamically
- LTE system design differs from LMR system design in many ways
  - More, lower-level cell sites
  - Lower-powered user equipment
  - Optimized for data and video today
  - System is powered up and on the air 24/7 even when not in use
  - Data rates vary depending upon
    - Your location in relationship to the cell site center
    - The number of users within the same cell sector and their data demands
- LTE systems will be built, expanded, and expanded more

Public Safety LTE Devices



Generation One

- Narrowband mobile and handheld
  - Conventional and trunked
  - 700/800-MHz coverage
  - Analog and P25
  - Multi-channel
  - Mobile and portable
  - Power 1 to 25 watts
- LTE broadband
  - USB modem 200 MW
  - LTE for Public Safety only
  - LTE and 3G capable (future)
  - Data only

Generations Two and Three

- LMR
  - Same as generation one
- LTE
  - Embedded LTE modem in notebook computers
  - Trunk-mount standalone modem for use with laptops
  - First handheld devices (LTE data-only)

Generation Four (Three Years from Now)

- Single mobile and handheld devices
  - 700/800-MHz conventional/trunked/analog/P25 voice
  - LTE 700-MHz Public Safety broadband data

THEN

- Single mobile and handheld devices
  - 700/800-MHz conventional/trunked/analog/P25 voice
  - LTE 700-MHz Public Safety broadband data
  - Commercial LTE 700-MHz network support
  - Commercial 3G network support

  - Price: Unknown

What Can be Done with Broadband

GIVING EYES TO PUBLIC SAFETY

EMS Service Examples

- On-scene video from fixed/mobile cameras
  - Sent to responding units before arrival
- Live video from scene to hospital/dispatch
- Triage video to hospital
- Live video to scene from helicopters/planes
- Track location of each responding and on-scene unit
  - Future: track location of each firefighter/EMS person on the scene
- Full ultrasound from scene to hospital
- Full, simultaneous transmission of EKG and vital signs
  - Heart Rate, BP, % of O2, etc.
- Patient info available on scene/collected on scene
- Fire, EMS, police and sheriff will be able to interoperate during major incidents!

Will Seattle Area Be One of the First to Roll Out Public Safety Broadband?

Existing Waivers and Leases

May 12, 2010: FCC issued conditional waivers to 21 early waiver petitioners

States (8): Alabama, Hawaii, Iowa, Mississippi, New Jersey, New Mexico, New York, Oregon

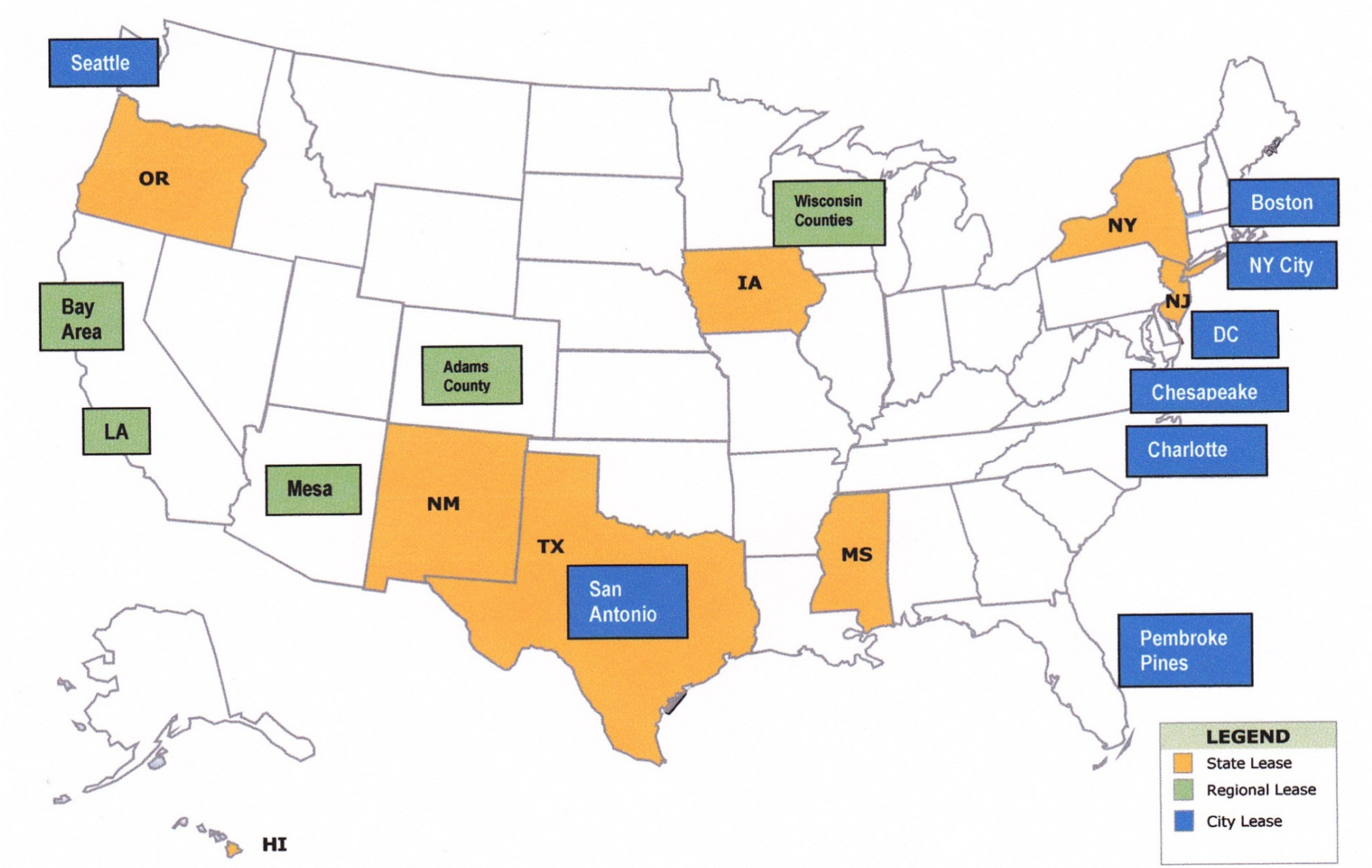
Counties/Regions (5): Adams County-Denver Airport (CO), Bay Area (CA), Mesa-TOPAZ (AZ), San Antonio (TX), Wisconsin Counties (WI)

Cities (8): Boston (MA), Charlotte (NC), Chesapeake (VA), Washington (DC), Los Angeles (CA), New York City (NY), Pembroke Pines (FL), Seattle (WA)

September 9, 2010: FCC approved 20 PSST spectrum leases for above entities with exception of Alabama, which was not ready to proceed

May 12, 2011: FCC issued conditional waiver to State of Texas

Waiver Entities



Waiver Entities (cont.)

S-1 Hawaii (HI)
S-2 Iowa (IA)
S-3 Mississippi (MS) ....$70.0 million BTOP Grant
S-4 New Jersey (NJ) .... $39.6 million BTOP Grant
S-5 New Mexico (NM) .... $38.7 million BTOP Grant
S-6 New York State (NY)
S-7 Oregon (OR)
S-8 Texas (TX)
R-1 Adams County-Denver Airport (CO) ….. $12.1 million BTOP Grant
R-2 Bay Area (CA) .... $50.0 million BTOP Grant (Motorola)
R-3 Los Angeles (CA) .... $154.6 million BTOP Grant
R-4 Mesa-TOPAZ (AZ)
R-5 Wisconsin Counties (WI)
C-1 Boston (MA)
C-2 Charlotte (NC) .... $16.7 million BTOP Grant
C-3 Chesapeake (VA)
C-4 District of Columbia (DC)
C-5 New York City (NY)
C-6 Pembroke Pines (FL)
C-7 San Antonio (TX)
C-8 Seattle (WA)

S – States………8
R – Regions……5
C – Cities……..__8
21

Seattle

- Spearheaded by Bill Schrier, CTO City of Seattle
  - Bill has been instrumental in obtaining the spectrum and funding
- Request for information packets received 2/29/12
  - RFI was not only for Seattle but surrounding counties as well
  - Many responses including public/private partnerships
- Next steps
  - Will depend on FirstNet organization, which will be managing the network and build-out
  - Will also depend on funding
- Hopefully, Seattle and surrounding areas will find a way to make this happen
  - Building out now would mean a 3-5 year jump on most of the rest of the U.S.
- **UPDATE: NTIA has “strongly recommended” that all waiver recipients “stand down”**

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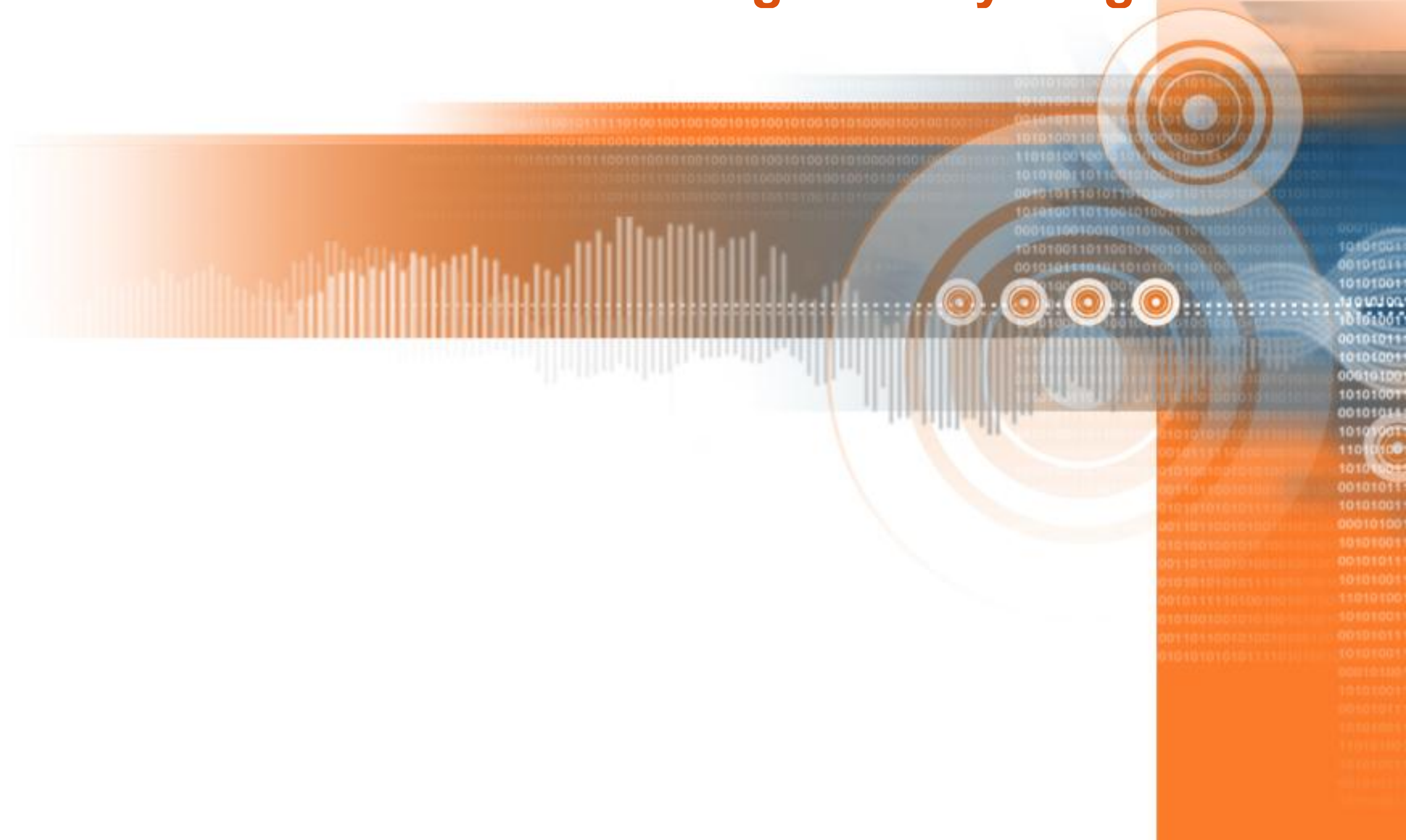
Public Safety Broadband Changes Everything!



Public Safety Broadband

- Nationwide
- Interoperable
- Adds data, streaming audio, video to Public Safety in the field
- Enables operations center, incident commander to see in real time
- Dispatch will include video from nearest camera
  - Incoming units will be able to see what they are heading into
- IC and swat commanders will be able to see what sniper sees through his/her scope
- Real-time, full-motion video (within reason) will change Public Safety forever
- Other applications will make life on the street easier, safer!

LTE Benefits

- LTE Public Safety Broadband
  - Mission-critical data and video services to Public Safety communications
  - Nationwide, fully interoperable data/video network
  - Lower-cost devices because they are based on commercial technology
  - Public Safety will have full control of Public Safety LTE network
    - Won’t have to share network with commercial customers
- Network will be secure, hardened, and mission-critical in nature
  - First nationwide network for first responders—this is a big deal!
- Public/private partnerships could provide both Public Safety and commercial broadband services to rural America
  - And faster than any other proposed rural broadband plan!

Mission-Critical Voice over the LTE Broadband Network

It Won’t Be Available for a While If At All!

Typical Commercial Voice Services

- Voice for telephone calls
  - Single user to network for voice calls
  - Dial or receive call from another person
- Push-to-talk services
  - Available today on some 2G and 3G networks
  - Will come to LTE after voice calls (commercial)
  - Non-mission-critical in nature
  - Ability to assign multiple talk groups

LTE: Multiple Types of Voice

- Types
  - VoIP for telephone calls
  - On-network push-to-talk
  - Off-network (simplex, tactical, talk-around)
- Two levels of voice services
  - Non-mission-critical (administrative)
  - Mission-critical (full public safety grade)

On-Network Voice Services

- Administrative on-network push-to-talk
- Mission-critical on network push-to-talk
  - Multi-zone dispatch and citywide
  - Incident coordination channels
- What we know
  - Non-mission-critical PTT is possible
- What we don't know
  - What else is possible and when

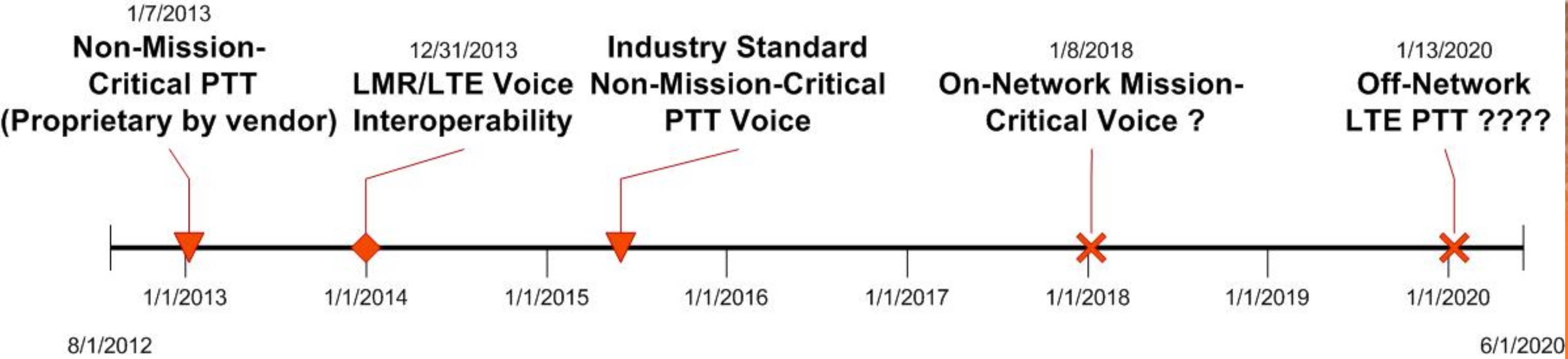
Off-Network Voice Services

- Commercial operators do NOT understand this requirement
  - They believe that on-network voice is all that is required
- Yet Off-Network voice is one of the most important elements of public safety communications
- In-building, out-of-network coverage voice communications is still vital!

Off-Network Voice

- In-building coverage
- Out-of-network coverage
- Multiple channels available
  - Wild fires require MANY off-network channels
- Easy to use, fast to set up
- TODAY: no support for off-network voice
  - Standards body only starting to look at this

LTE Mission-Critical Voice Timeline



1/7/2013
Non-Mission-Critical PTT (Proprietary by vendor)

12/31/2013
LMR/LTE Voice Interoperability

Industry Standard Non-Mission-Critical PTT Voice

1/8/2018
On-Network Mission-Critical Voice ?

1/13/2020
Off-Network LTE PTT ????

Note: Timeline is an estimate based on discussions with vendors and my own assessment of the technology

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